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THE ENGINEER'S ROLE IN METROPOLITAN TRAFFIC PLANNING

By Lloyd Braff

CITY PLANNING AND AIR TRANSPORT DIVISIONS

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AMERICAN SOCIETY OF CIVIL ENGINEERS

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PAPERS

THE ENGINEER'S ROLE IN METROPOLITAN TRAFFIC PLANNING

By Lloyd Braff[1]

Synopsis

Departmental cooperation within the city government makes possible effective long-range traffic planning. The engineer is involved in this work in several specialized capacities. The organization and application of highway capacity studies and origin-destination surveys, the prediction of trends in the density of traffic, and the coordination of public utility planning under the over-all plan are all functions of the engineer. The problems found in this work are many and varied; and their solution is vital to community growth.

Introduction

Everyone who drives in almost any urban area is aware of traffic congestion, delay, accident hazards, inadequate streets, and lack of parking spaces. They recognize that the increasing number of automobiles has expanded the area of cities and created demands for better streets and highways. In rapidly growing areas, motorists have seen many small rural roads suddenly exposed to traffic as a cotton field is converted into a subdivision full of homes.

In most urban areas, the engineer is assigned the prodigious task of solving the traffic problems. Throughout the evolution and revolution created by the automobile, the engineer has studied causes and effects. During this process he has created engineering specializations such as traffic engineering and traffic planning.

The attack on the traffic dilemma is divided into those activities that can be accomplished immediately, and those classified as long-range plans. The immediate activities are the less expensive methods of increasing the capacity of existing streets in the interim period before a long-range plan can be completed. This phase might be classified in three broad categories: Operations, planning, and construction. In smaller cities, all three usually are the re-

Note.—Written comments are invited for publication; the last discussion should be submitted by November 1, 1953.

[1] City Traffic Engr., Dallas, Tex.

sponsibility of one engineer, but as the city grows, these become separated into departments for traffic, planning, and public works, and each is headed by a separate engineer.

The purpose of this paper is to describe the role of the engineer in attacking both the immediate and long-range traffic programs. Inasmuch as most cities are using similar methods to cope with the immediate problem, this phase will be minimized. Emphasis will be placed on those techniques developed by engineers which are applicable to the development of a long-range traffic plan.

Immediate Program

Operations.—Traffic engineers use many devices to obtain maximum efficiency and safety from the existing street system. Through national standardization of signs, signals, and markings, motorists may travel throughout the United States and expect to have uniform markings and warnings. By this means, the stranger may be guided with safety over any street system.

As traffic volumes increase on city streets, the traffic engineer may prohibit parking during rush hours (and at all times on narrow streets); he may protect major streets by erecting stop signs at minor streets; and he may signalize intersections of major streets. Also, he may create one-way streets, eliminate "jogs" along major streets, and channelize dangerous intersections.

In areas of heavy parking demand, the traffic engineer may establish parking time limits to cause a "turnover" of curb space, and he may lessen congestion by establishing orderly bus zones and truck spaces. At some intersections where traffic volumes exceed the capacity of the streets, he may eliminate the congestion by completely redesigning the roadways, or by adding storage lanes so that the capacity of the new intersection equals that of the streets leading to it. These are only a few of many devices by which the engineer may increase the efficiency of the existing street system.

Planning.—The planning engineer also has at his disposal methods in which he may assist in the immediate problem of getting the most out of existing facilities. Through zoning, the planning engineer can require off-street parking areas in connection with the construction of new buildings. Through this device, each vehicle taken off the street provides more area of street surface for moving traffic. Zoning control, such as the elimination of strip zoning, does much to relieve traffic arteries of the marginal conflict created by uncontrolled development. In subdivision regulations, the planning engineer may reserve rights of way adequate for major thoroughfares and secondary thoroughfares and for providing drainage easements. Through proper subdivision regulations, both the immediate problems and the long-range problems may be handled simultaneously.

Construction.—The public works engineer also is in a strategic position to gain maximum efficiency from the existing street system. By concentrating street improvements on the major thoroughfare system, maximum traffic volumes can be accommodated with minimum expenditures. He designs streets of adequate size to accommodate present traffic volumes and is guided by future traffic estimates to make provisions in his design so that the street may be altered for anticipated volumes. Every city has several intersections

at which traffic volumes exceed the capacity of the existing pavement. Through relatively inexpensive construction, the roadways can be redesigned by adding lanes so that the resulting capacity of the intersection will equal the capacity of the roadways leading to it.

The functioning of the major thoroughfare plan depends on the street standards established by the public works engineer and the programming of street repaving and resurfacing at locations where traffic demands are greatest.

Long-Range Plan

Officials responsible for traffic have long recognized the need for techniques to determine the traffic requirements for metropolitan areas which will meet present needs and be adaptable to future traffic movements. They accept the fact that a comprehensive major thoroughfare plan is a necessity. However, because of the rapid increases in vehicle registration and vehicular use during the last decade, traffic volumes have reached such proportions that it has been necessary to study the traffic capacities of streets and to determine all elements which affect capacity. Such a study[2] has been made and reported by O. K. Normann of the United States Bureau of Public Roads (USBPR). Through this research, engineers now have a tool to guide them in traffic planning.

Another tool recognized as a vital necessity is the comprehensive origin-destination survey also developed by the USBPR. In this type of survey, the origin and destinations of all trips made within a metropolitan area are determined through a proved sampling procedure.

Traffic engineers and planning engineers who have access to the origin-destination survey can make a sound approach to the study of the traffic requirements of a city for both present and future conditions. Armed with these basic data, they can test the adequacy of the existing street system and the major thoroughfare plan, and revise the plan, if necessary. By proper procedures, they can make a logical approach to the establishment of priorities in their capital improvement programs.

Revision of the Dallas, Tex., Major-Thoroughfare Plan.—To illustrate the role of the engineer in planning for traffic, the City of Dallas is an example of one way in which a city is endeavoring to solve its traffic dilemma. During the past few years, the growth of Dallas has been phenomenal. Its population increased from 294,734, in 1940, to 432,927, in 1950. The city's population on January 1, 1953, was estimated to be 535,000. Similarly, Dallas County, in Texas, increased from 398,564 persons, in 1940, to 612,318, in 1950. Dallas County is the most densely populated county in Texas and exceeds by more than 50% the second most densely populated county, in persons per square mile. The area of the City of Dallas in 1945 was 45 sq miles, and at the end of 1952 was 172 sq miles. It is probable that the area will exceed 200 sq miles by 1954.

This rapid growth has far surpassed any predictions made as late as 1947. Population in 1952 exceeded that predicted for 1970. Similarly, vehicle

[2] "Principles of Highway Capacity Research," by O. K. Normann, *Transactions*, ASCE, Vol. 117, 1952, p. 913.

registration has outgrown the most optimistic predictions. More than 250,000 vehicles were registered in Dallas County in 1952. In 1950, there were 2.95 persons per passenger vehicle in Dallas County. The use of the automobile in Dallas equals that of any part of the United States.

During this period of rapid expansion, the construction of major thoroughfares lagged. Dallas has extended beyond the area encompassed by its original major thoroughfare plan. Because of all these factors, it was found necessary to restudy the original major thoroughfare plan and to establish a realistic priority program for capital improvements. During 1952, the city began a comprehensive analysis of both present and future street needs so that it could revise its major thoroughfare plan.

Before starting such an undertaking, the city recognized the need for the best available basic data. At the request of the city in 1950, the Texas Highway Department, the USBPR, and the County of Dallas joined to conduct an origin-destination survey. This survey covered a metropolitan area of 230 sq miles. In addition, origin-destination information was obtained at all roads leading to six cities beyond the metropolitan area.

In selecting the sample for the origin-destination survey, a complete land-use map was prepared for the entire metropolitan area. For this purpose, the location of every dwelling was noted. This detail was considered vital in order to make the origin-destination survey adaptable to future expansion. After the survey, the City Planning Department completed the land-use map for the remainder of Dallas County.

The results of the survey were first made available for application in March, 1952. The first use of the survey data was to analyze three proposed routes for an east-west expressway. The survey made it possible to select the route that would best serve the city.

Traffic-volume counts are not helpful as a guide in planning the major thoroughfare system in Dallas. Many of the streets are narrow and, during rush hours, traffic "spills over" into adjacent parallel streets. In many instances, motorists make circuitous trips to avoid congested areas. For the purpose of conducting a thorough study, therefore, traffic volume data were not used. Origin-destination survey data were used exclusively. The major thoroughfare system was superimposed on a map of zones used for the origin-destination survey. Each major thoroughfare was coded. Traffic between all zones was allocated to major thoroughfares on the most logical route between the zones, on the assumption that all major thoroughfares were equally good. By this process, the 1950 traffic volumes were assigned to the entire network of thoroughfares, and the average daily allocated traffic was known for every section of that street. These data included both trucks and passenger vehicles. It is reiterated that this flow map is 1950 "allocated" traffic flow as distinguished from 1950 actual traffic flow.

Another of the studies being conducted concerns the available right of way and pavement width over the entire major-thoroughfare network. From these data, the theoretical capacity of every section of every major street will be computed. By comparing these capacities to the 1950 traffic allocated to the same network, the deficiencies in the existing network will be known. The

next study will be the computation of traffic capacities based on the maximum pavement that could be constructed on the existing rights of way.

Both of these procedures will guide engineers in selecting priorities and geometric standards for improvements in the thoroughfare network. Neither of these steps, however, provides for probable future needs.

For future traffic requirements, predictions will be made of population increases for a twenty-year period. The increment of population increase during this period will be distributed to the zones used for the origin-destination survey. By utilizing the land-use maps, by zoning, and through knowledge of the limitations of future population distribution imposed by the Dallas drainage area, future population distribution can be predicted with reasonable accuracy. The 1950 origin-destination data will be expanded, by zones, on the basis of a composite of these factors: (1) The ratio of future population to 1950 population; (2) the trend of number of persons per vehicle; and (3) the trend of gasoline consumption in gallons per vehicle per year. The added trips by a larger population, the fact that more persons will operate automobiles, and the fact that vehicles will be driven more miles each year will all be taken into consideration. It is assumed that the type of trips will remain the same. In approximately ten areas where it is known that new industrial or retail areas will be established, a new origin-destination distribution will be made of those areas based on patterns established in similar areas in the 1950 survey. From these expanded origin-destination data, a new set of desire lines will be made for the purpose of determining the possibility of a shift in the directions and relative size of the major desire lines. This information will be used to determine where a network of expressways should be planned to serve future traffic movements.

When a network of expressways has been located, it will be superimposed over the major thoroughfare system on the map of zones. The expanded origin-destination data then will be allocated to the combined network of expressways and major thoroughfares. When this is completed, a comparison of the ultimate traffic demands and the 1950 demands will serve as a guide to discovering those places where additional rights of way are required, and the size of streets needed to accommodate future volumes.

It would be unwise to plan a comprehensive street system costing millions of dollars unless a comparison were made of present needs and of estimated future needs, because a network of expressways will change the travel pattern in many locations by a rotation of 90°. For example, traffic north of a city under an existing street system may be concentrated on north-south major streets. If a north-south expressway were built to supplement the street system, a majority of motorists would use the expressway and then confine their surface travel from the expressway to their homes on an east-west street. Unless an analysis of the future network of expressways and major streets were made, therefore, expenditures would have been made on the north-south streets (in this example); but in the outlying area the east-west streets would carry the majority of traffic and otherwise might have been neglected. This fact is frequently overlooked.

In Dallas, the city manager has established a Capital Improvements Review Board consisting of the finance officer, the director of public works, the superintendent of water and sanitary sewers, the city planning engineer, and the traffic engineer. It is the function of this board to coordinate all capital improvements in the city. Through this committee, no street improvement will be undertaken until any water, sewer, or other utility work is completed first. Priorities of all agencies must fit into the program. When a program is developed, it is presented to the city council as a guide for action. The technique of traffic planning described in this paper, even though incomplete, has guided the city council in one bond program for street improvements.

This technique will make it possible to estimate all the street deficiencies, estimate the cost of improvements, and prepare a construction program. It is anticipated that, once a community is cognizant of the deficiencies in its street system and the cost to modernize it, it will request that a comprehensive study of financing methods be made to accelerate the realization of the street program.

These have been the highlights of the numerous problems involved in planning for traffic in Dallas. Such planning in Dallas (or in any other metropolitan area) responds to engineering analysis and requires the coordination and cooperation of traffic engineers, planning engineers, and public works engineers, all of whom must concentrate on a common objective. In Dallas, that coordination and cooperation are to be found, and it is hoped that the plan will be adopted and put into practice.